This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.

If you have a suggestion to make the keys better, please fill out the short survey here.

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

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1. Simplify the expression below and choose the interval the simplification is contained within.

$$13 - 4^2 + 11 \div 17 * 15 \div 10$$

The solution is -2.029, which is option B.

A. $[29.43, 30.3]$

29.971, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

B. $[-2.83, -1.86]$

* -2.029, this is the correct option

C. $[-3.87, -2.33]$

-2.996, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[28.66, 29.69]$

29.004, which corresponds to two Order of Operations errors.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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2. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{-2160}{9}}$$

The solution is Not a Real number, which is option B.

A. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

B. Not a Real number

* This is the correct option!

C. Irrational

These cannot be written as a fraction of Integers.

D. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

E. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\sqrt{240}i$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

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3. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{9 - 77i}{8 - 6i}$$

The solution is $5.34 - 5.62i$, which is option C.

A. $a \in [533, 535]$ and $b \in [-6.5, -4.5]$

$534.00 - 5.62i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [-4.5, -2.5]$ and $b \in [-8, -6]$

$-3.90 - 6.70i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [4.5, 6.5]$ and $b \in [-6.5, -4.5]$

* $5.34 - 5.62i$, which is the correct option.

D. $a \in [1, 2.5]$ and $b \in [12, 14]$

$1.12 + 12.83i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [4.5, 6.5]$ and $b \in [-562.5, -561]$

$5.34 - 562.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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4. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(4 - 9i)(-2 - 10i)$$

The solution is $-98 - 22i$, which is option D.

A. $a \in [79, 87]$ and $b \in [56, 62]$

$82 + 58i$, which corresponds to adding a minus sign in the second term.

B. $a \in [-16, -7]$ and $b \in [88, 93]$

$-8 + 90i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

C. $a \in [-99, -94]$ and $b \in [19, 23]$

$-98 + 22i$, which corresponds to adding a minus sign in both terms.

D. $a \in [-99, -94]$ and $b \in [-24, -21]$

* $-98 - 22i$, which is the correct option.

E. $a \in [79, 87]$ and $b \in [-64, -57]$

$82 - 58i$, which corresponds to adding a minus sign in the first term.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

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5. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{0}{15}} + \sqrt{4}i$$

The solution is Pure Imaginary, which is option D.

A. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

B. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

C. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

D. Pure Imaginary

* This is the correct option!

E. Nonreal Complex

This is a Complex number ($a + bi$) that is not Real (has i as part of the number).

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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6. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-8 + 5i)(-9 - 7i)$$

The solution is $107 + 11i$, which is option C.

A. $a \in [31, 44]$ and $b \in [98, 104]$

$37 + 101i$, which corresponds to adding a minus sign in the first term.

B. $a \in [65, 78]$ and $b \in [-37, -29]$

$72 - 35i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

C. $a \in [107, 110]$ and $b \in [11, 15]$

* $107 + 11i$, which is the correct option.

D. $a \in [107, 110]$ and $b \in [-15, -7]$

$107 - 11i$, which corresponds to adding a minus sign in both terms.

E. $a \in [31, 44]$ and $b \in [-101, -99]$

$37 - 101i$, which corresponds to adding a minus sign in the second term.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

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7. Simplify the expression below and choose the interval the simplification is contained within.

$$5 - 13 \div 19 * 7 - (20 * 4)$$

The solution is -79.789, which is option D.

A. $[84.7, 85.14]$

84.902, which corresponds to not distributing addition and subtraction correctly.

B. $[-79.27, -77.74]$

-79.158, which corresponds to not distributing a negative correctly.

C. $[-75.97, -73.49]$

-75.098, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[-80.42, -79.52]$

* -79.789, which is the correct option.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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8. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{-1575}{15}} + \sqrt{60}$$

The solution is Nonreal Complex, which is option B.

A. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

B. Nonreal Complex

* This is the correct option!

C. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

D. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

E. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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9. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-36 - 77i}{-1 + 6i}$$

The solution is $-11.51 + 7.92i$, which is option E.

A. $a \in [-428, -425.5]$ and $b \in [6, 8.5]$

$-426.00 + 7.92i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [13, 14.5]$ and $b \in [-4.5, -3]$

$13.46 - 3.76i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [-12.5, -11]$ and $b \in [292.5, 294]$

$-11.51 + 293.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [35, 37.5]$ and $b \in [-13.5, -12.5]$

$36.00 - 12.83i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [-12.5, -11]$ and $b \in [6, 8.5]$

* $-11.51 + 7.92i$, which is the correct option.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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10. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{-525}{5}}$$

The solution is Not a Real number, which is option B.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Not a Real number

* This is the correct option!

C. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

D. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

E. Irrational

These cannot be written as a fraction of Integers.

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{105}i$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.
